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Akentrobuthus leleupi, a new genus and species of humicolous scorpion from eastern Zaïre, representing a new subfamily of the Buthidae

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SYNOPSIS

Akentrobuthinae, a new subfamily of the Buthidae, is erected for *Akentrobuthus leleupi* gen. et sp. nov. This new subfamily is typified by a distinctive combination of characters among which are: subpentagonal sternum; suboval stigmata; distal middle lamellae of pectines rounded, fulcra absent; tibial spurs absent; the two basal teeth of the superior row of the chelicera movable finger reduced, the proximal one being extremely reduced or absent in most adult specimens.

Akentrobuthus leleupi is an endemic humicolous scorpion from primary and secondary forests of the Kivu Province in eastern Zaïre. With an adult body length of 16 mm it is one of the smaller species of Buthidae known. Only females have been found so far. Apically perforated sensory macrosetae, for which a contact chemoreceptor function is proposed, are described as a remarkable feature of this new species, the only other scorpion known to have these specialized setae being *Microtityus rickyi* Kj.-Waer., 1966, a neotropical buthid endemic to Trinidad.

RÉSUMÉ

Akentrobuthinae, une nouvelle sous-famille des Buthidae, est créée pour contenir *Akentrobuthus leleupi* gen. et sp. nov. Les caractères diagnostiques de cette nouvelle sous-famille comprennent entres autres: sternum presque pentagonal; stigmates ovales; pièces médianes distales des peignes arrondies, fulcres absents; éperons tibiaux absents; deux dents basales externes du doigt mobile des chélicères réduites, la plus basale fortement atrophiée ou absente chez la plupart des adultes.

Akentrobuthus leleupi est essentiellement humicole et endémique des forêts ombrophiles primaires et secondaires dans la Province du Kivu au Zaïre. Cette espèce est l'une des plus petites des Buthidae, l'adulte le plus long ne mesurant que 16 mm. Les mâles n'ont pas encore été trouvés. Des poils sensoriels, perforés á leurs extrémités distales et pour lesquels une fonction chémoréceptrice est envisagée, représentent un des traits remarquables de cette nouvelle espèce, ce genre de poils n'éyant été décrits que pour une seule autre espèce, *Microtityus rickyi*, une espèce néotropicale endémique de Trinidad.

INTRODUCTION

While a few African scorpions can be described as forest-dwelling, no truly or permanently humicolous species has been described from this continent. The only truly humicolous scorpion that has been known to me is *Belisarius xambeui* E. Simon, a monotypic genus endemic to forests and caves in the south-eastern Pyrenees mountains in south-western France, which belongs to the family Chactidae. Coineau (1974: 20) reports this species from '. . . sous les pierres enfouies dans l'humus des forêts du Vallespire'. *B. xambeui* is almost completely anophthalmous, a condition most certainly brought about through evolutionary regression induced by factors in its habitat. It is interesting to note that this species is a chactid, a group surmised to be the most primitive of contemporary families.

Tityus serrulatus Lutz & Mello, a neotropical Buthid species from Brazil, has been reported (Vachon, pers. comm.) as living in forest litter and in saproxylophilous conditions. I have, however, not been able to find any confirmation of this in available literature.

The discovery of the new scorpion described below from primary forests of eastern Zaïre has highlighted many interesting problems, most of which cannot be solved in the present paper as investigations of many aspects of scorpion phylogeny in the Ethiopian Faunal Region are still in the preliminary stages. There is no doubt, however, that *Akentrobuthus leleupi* will contribute greatly towards a phylogenetic reappraisal of the family Buthidae.

Family BUTHIDAE

Subfamily **Akentrobuthinae** subfam. nov.

Derivation: from type genus.
Type genus: *Akentrobuthus* gen. nov. by present designation.

Diagnosis

Presently composed only of monotypic type-genus *Akentrobuthus*. *Akentrobuthus* can be separated from all other genera of the family Buthidae by the following combination of characters: the two basal teeth of the superior row of the chelicera movable finger, characteristic of all known taxa of Buthidae, reduced, the proximal one being extremely reduced or absent in adult specimens; stigmata sub-oval to round in shape (fig. 17); no tibial spurs on legs III and IV; two small inferior teeth at inner base of fixed finger of chelicera; sternum subpentagonal in shape; pectines without fulcra; presence on various parts of the body and appendages of apically perforated sensory macrosetae of a kind hitherto undescribed among African genera of Buthidae (figs 22–23 and 25–26); outer tarsal spur unfurcated and with only one basal seta; adult specimens with only two lateral eyes, a few nymphs and juveniles with a third lateral eye on one side only, but never with three lateral eyes on both sides (the percentage of occurrence of a third eye on one side only in the sample available is 9% in adults, 20% in juveniles and 100% in nymphs, the percentage of occurrence of three lateral eyes on both sides in all life stages is *nil*); anterior margin of prosoma recurved and with a pronounced median notch, see fig. 8; a well-developed sub-aculear tooth or spine; pectinal teeth 8–9 in ♀; size very small, adults not exceeding 16 mm in total body length; male unknown.

DISCUSSION

Having studied either material or adequate descriptions of the 41 genera (see Vachon 1973: 906) belonging to the family Buthidae, I have no hesitation in creating this new subfamily for the new genus *Akentrobuthus*, because it is clearly distinguishable from any other genera or groups of genera by the combination of characters listed in the above diagnosis. Of the characters defined in this diagnosis a few are shared individually, but never in the same combination, by a few buthid genera. These are:

(1) a subpentagonal sternum which is also found in the following four small genera: *Butheoloides* Hirst, 1925 (2 species from Morocco and Mali Republic in North Africa), *Karasbergia* Hewitt, 1913 (1 species from South West Africa), *Microtityus* Kjellesvig-Waering, 1966 (2 species from Trinidad and Venezuela in South America), *Orthochirus* Karsch, 1891 (4 species from North and North-East Africa, Arabian Deserts, Iran and India), *Charmus* Karsch, 1879 (India);

(2) absence of tibial spurs on legs III and IV which also occurs in the following three small genera: *Anomalobuthus* Kraepelin, 1900, *Isometrus* H. & E., 1828, and *Microtityus* Kj-Waering, 1966;
(3) predominant presence of only two lateral eyes on prosoma, otherwise found only in the monotypic genus *Karasbergia* Hewitt, 1913.

Although *Akentrobuthus* must clearly remain within the family Buthidae as it has no ventral trichobothria on the pedipalp tibia and has two small inferior teeth at inner base of fixed finger of chelicera, the need to isolate the genus within this family by allocating it to a separate subfamily is further indicated because it shares five of the diagnostic characters with taxa of the family Chactidae. These are:

(1) subpentagonal sternum with traces of fusion and tripartite origin;
(2) combs simple, composed of few segments, distal middle lamellae rounded, fulcra missing;
(3) no tibial spurs;
(4) not more than two lateral eyes on both sides of prosoma;
(5) suboval to round stigmata.

It is likely that characters 3 and 4 represent states that arose as a result of regression induced by a humicolous habitat rather than characters derived from phylogenetic affinities with primitive chactoid taxa. The percentage of occurrence of a third eye on one side only in the sample available is 9% in adults, 20% in juveniles and 100% in nymphs. The percentage of occurrence of three lateral eyes on both sides in all life stages is *nil*. Although the size of the sample available is small it is nevertheless permissible to infer that the occurrence of a third lateral eye is subject to ontogenic regression. This in turn suggests phylogenetic regression of this character. The presence of the specialized sensory chemoreceptor macrosetae and the fan-like lamina at the distal end of the pedipalp-hand fingers are on the other hand apomorphous adaptations almost certainly induced by habitat factors.

Character states 1, 2 and 5 are known to be primitive or plesiomorphic for scorpions and their presence in *Akentrobuthus*, while strongly indicating a primitive origin, makes the search for a sister-group within Buthidae a very difficult task at this stage, because affinities of two taxa can be best demonstrated by use of shared derived character states whereas primitive similarities contain no phylogenetic information.

While it is possible to propose a sister-group in one instance on the basis of a set of apomorphous character states such as for example the presence of two small inferior teeth at the inner base of the chelicera fixed finger as in genera *Buthiscus* Birula, 1905 and *Ananteroides* Borelli, 1911, possession of other synapomorphies such as a sub-aculear spine as in genera *Babycurus* Karsch, 1886 and *Lychas* C. L. Koch, 1845 indicates possible affinity with a different sister-group and therefore a different lineage. If anything, the contradictory nature of the similarities between *Akentrobuthus* and the various taxa investigated tend to lead one to suspect character convergence. This in turn only serves to emphasize, in addition to the striking diagnostic characters listed earlier in this paper, the need to create a new subfamily for *Akentrobuthus*.

Thus data presently available indicate that *Akentrobuthus* represents an isolated genus distinguishable from other groups within the Buthidae and that those genera which share some of the characters diagnostic for Akentrobutinae do so by virtue of convergence rather than by recent phylogenetic affinities.

Genus **Akentrobuthus** gen. nov.

Derivation: ά-κεντρος (Gr.) = without spur + Buthus.
Gender: masculine.
Type species: *Akentrobuthus leleupi* sp. nov. by present designation.

Diagnosis

See subfamily diagnosis above. Presently monotypic. Additional generic diagnostic characters include: only one external accessory granule or tooth near base of each row of teeth on movable finger of pedipalp hand; pedipalp hand and finger without any keels.

Akentrobuthus leleupi sp. nov.

Derivation: Named in honour of Dr N. Leleup who collected most of the specimens for the species described.

Diagnosis

See genus diagnosis above.

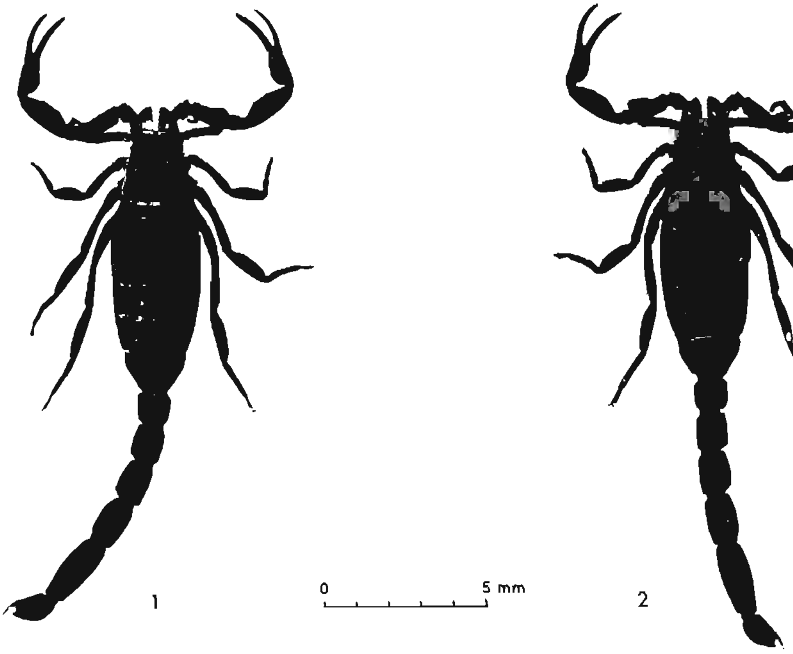
Description

The type series consist exclusively of females. The following description is based on the holotype female.

Granulation. The following surfaces are agranular but microscopically shagreened, with an overall unburnished appearance: pedipalp hand and fingers, dorsal, external and ventral intercarenal surfaces of tibia, ventral and external intercarenal surfaces of femur, intercarenal surfaces of coxa and trochanter; coxae and trochanters o legs I–IV; inner and ventral surfaces of prefemur of legs I–IV; all intercarenal surfaces of femur and tibia of legs I–IV; basitarsi and tarsi of legs I–IV; basal segment and chela of chelicera; sternum, genital operculum and pectinal segments; sternites III–VII excepting posterior half; telson. The following surfaces are granular to a greater or lesser extent: dorsal and internal intercarenal surfaces of femur and internal surface of tibia of pedipalps with scattered granules; prosoma coarsely granular throughout with no definite ridges, except at outer margins as in fig. 8; tergites I–VII with scattered granules, figs 9–10; external surfaces of prefemur of legs I–IV with scattered granules; posterior half of sternite VII with scattered granules, fig. 18; intercarenal surfaces of cauda I–V.

Colour. Colour given using the ISCC-NBS Colour Designation (Kelly & Deane 1965). Overall coloration, fairly uniform light orange yellow No. 70, with dorsal and lateral surfaces of body appendages lightly to moderately infuscated, motley and darkly patterned as shown in figs 1–10. Cauda IV and telson moderate orange yellow No. 71; cauda V brownish orange No. 54.

Chelicerae (figs 11–12). Teeth as illustrated. An important feature is that the two basal teeth of the superior row of the chelicera movable finger, characteristic of all known taxa of Buthidae (Vachon 1963: 163 and pers comm. 1974), are greatly reduced, the

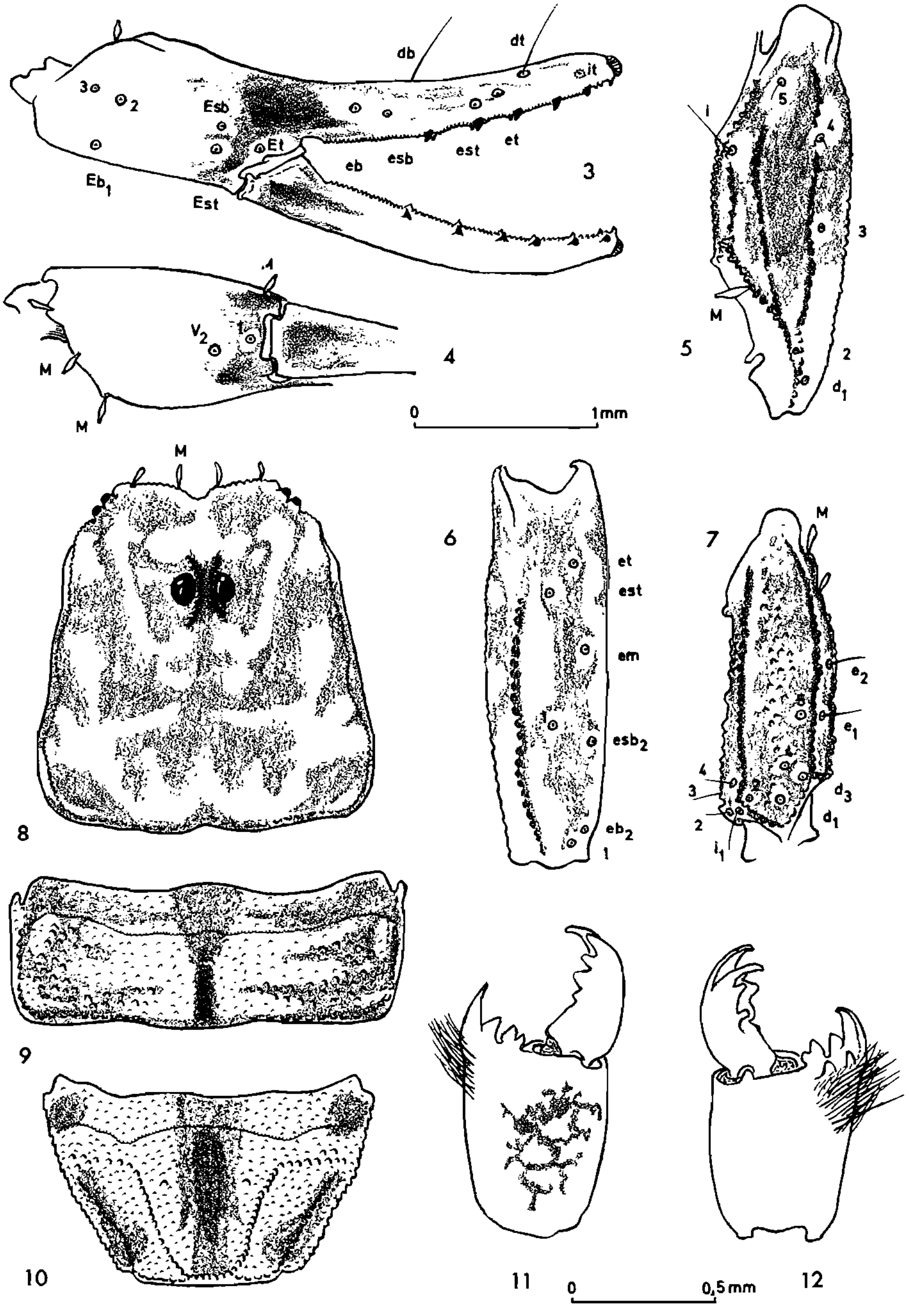


Figs 1–2. *Akentrobuthus leleupi* sp. nov. Holotype. 1. Dorsal aspect. 2. Ventral aspect. Scale as indicated.

proximal one being extremely reduced or absent in most specimens; other teeth of movable finger superior row, typical for the family, namely one median, one subdistal and one distal. Inferior row of movable finger with three teeth. Fixed finger, with a superior row of four teeth (basal, median, subdistal and distal) and two small inferior teeth at inner base.

Pedipalps (figs 3–7, 15–16). Hand: round in cross-section, width equal to height, without traces of any keels or tubercles. Fingers: long and slender, without traces of any keels or tubercles; distal ends, each with a conspicuous and transparent, thin and convex lamina which is crescent-shaped and aligned to the sagittal plane of the fingers (see fig. 3); these laminae contain parallel and distally diverging tubules that appear to open through pores on the distal margin of these fan-like structures; as far as can be ascertained, *A. leleupi* is the first species of scorpion in which these unusual laminae have been observed and their possible functions are, at this stage, a matter of conjecture; fixed and movable fingers with six and seven rows of teeth respectively, with only one external accessory granule near base of each row as in figs 15–16. Pedipalp tibia and femur with moderately developed keels distributed as in figs 5–7.

Prosoma. As in fig. 8, anterior margin recurved and with a pronounced median notch, the latter being highly atypical in the family Buthidae; granulation coarse, but with no definite keels; median eyes small, superciliary ridge with two diverging rows of granules; holotype and nine paratype adults with only two lateral eyes on each side,



Figs 3–12. *Akentrobuthus leleupi* sp. nov. Holotype. 3. Right pedipalp hand, external aspect. 4. Id., ventral aspect. 5. Right pedipalp tibia, dorsal aspect. 6. Id., external aspect. 7. Right pedipalp femur, dorsal aspect. 8. Prosoma, dorsal aspect with granulation not drawn. 9. Tergite V. 10. Tergite VII. 11. Right chelicera, dorsal aspect. 12. Id., ventral aspect. M. apically perforated sensory macrosetae. 3–10, same scale as indicated; 11–12, same scale as indicated. Shading in figs 3–11, shows dark colour patterns and not form.

one paratype adult (NM 10707) with two lateral eyes on the left hand side and three on the right hand side; four paratype juveniles with only two lateral eyes on each side, one paratype juvenile (R. G. Mus. Congo 111304) with three lateral eyes on the left hand side and two on the right hand side; two nymphs (R. G. Mus. Congo 111304 and 115877) with two lateral eyes on one side and three on the other side; no type specimen has three lateral eyes on both sides. Thus the percentage of occurrence of a third eye on one side only in the sample available is 9% in adults, 20% in juveniles and 100% in nymphs. The percentage of occurrence of three lateral eyes on both sides in all life stages is *nil*. Although the size of the sample available is small it is nevertheless permissible to infer that the occurrence of a third lateral eye is subject to ontogenic regression.

Tergites. A blackened median keel present on posterior half of tergites II–VI but no lateral keels, see fig. 9; tergite VII with conspicuous raised median, two lateral and transverse keels as in fig. 10, median laterals and posterior marginal forming a sublabiate design.

Sternites. Respiratory stigmata suboval to round in shape and very small, see fig. 17; sternite VII with two median and two lateral weakly developed keels as in fig. 18.

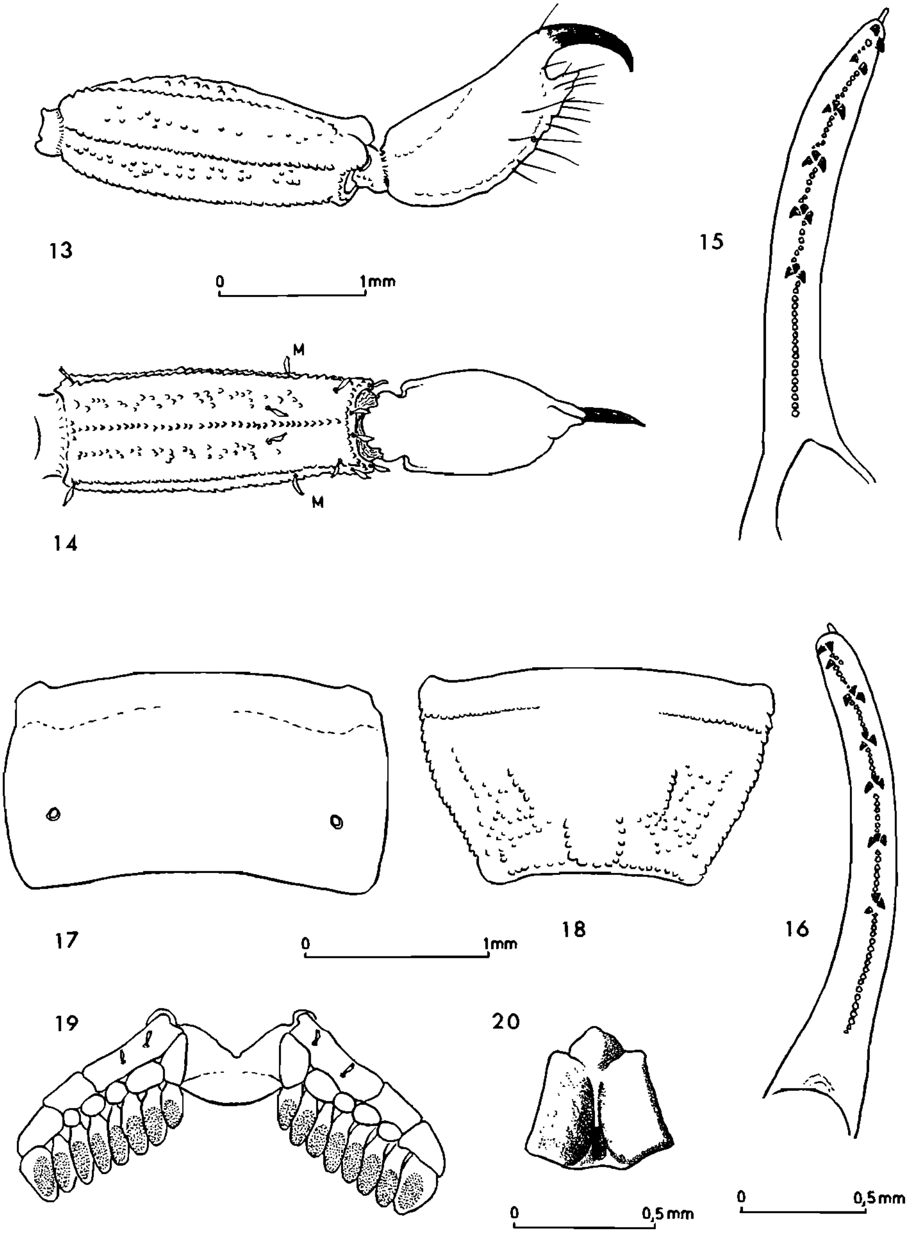
Legs. Prefemur and femur I–IV laterally compressed and with two longitudinal keels in dorsal and ventral regions; femur I–IV with two longitudinal keels on outer surfaces; tibia and basitarsus III–IV with two longitudinal keels on dorsal region; all other leg regions and segments unkeeled; tibial spurs totally absent on all legs; one inner and one outer pedal spurs present on III–IV, see figs 24 & 27, with the inner spur poorly developed and difficult to see in some specimens; outer tarsal spur not bifurcate, instead with a projection near its base, supporting a single long seta, see fig. 24; lateral lobes of all tarsi strongly truncated bearing 0–3 setae with no definite distribution; median lobe of tarsi poorly developed bearing only one seta at its reduced apical region; lateral claws (ungues) moderately developed and curved, median claw (unguicular spine) well developed in legs II–IV while reduced in leg I.

Cauda. Segments I–II with five pairs of keel namely dorsals, dorsolaterals, median laterals (or median accessory), ventro-laterals, ventrals; cauda III–IV with same distribution except for the median laterals which are poorly discernible in III and merely represented by scattered granules in IV; keels of cauda V as in figs 13 & 14; telson agranular, smooth but not shiny; aculeus moderately curved, with a well developed subaculear tooth or spine, see figs 13–14; pedicular plate of telson suboval in shape, with a few small granules on margin; anal frame of cauda V, U-shaped in cross-section.

Pectines. See fig. 19. Short. Three marginal lamellae, five middle lamellae of which distal three are almost round; fulcra totally absent. Pectinal teeth 8–9 in ♀; in holotype ♀ has 8–8 pectinal teeth.

Sternum. See fig. 20. Subpentagonal in shape; median furrow shallow but terminating posteriorly into a deep and subtriangular basal pit.

Trichobothria. A total number of 39 trichobothria which is orthobothriotaxic for type A, namely family Buthidae (Vachon 1973: 906); fixed finger with seven trichobothria, 4 external, 2 dorsal and 1 internal; hand with eight, 6 external and 2 ventral; tibia with thirteen, 1 internal, 5 dorsal, 7 external and no ventral; femur with eleven, 4 internal, 5 dorsal and 2 external. Distribution as in figs 3–7; Eb_2 of hand markedly



Figs 13–20. *Akentrobuthus leleupi* sp. nov. Holotype. 13. Cauda V and telson, left lateral aspect. 14. Id., ventral aspect. 15. Fixed finger of right pedipalp hand, ventral aspect. 16. Movable finger of right hand, dorsal aspect. 17. Sternite V. 18. Sternite VII. 19. Pectines and basal piece, ventral aspect. 20. Sternum. M, apically perforated sensory macrosetae. 13–14, same scale as indicated; 15–16, same scale as indicated; 17–19, same scale as indicated; 20, scale as shown. Shading in fig. 20, shows form and not colour pattern.

distal to Eb_1 and Eb_3, while Et is situated well into the lower distal half of hand as is also the case in the monotypic genus *Karasbergia* Hewitt; *db* and *dt* of fixed finger distal to *esb* and *et* respectively; d_3 and d_4 of tibia situated on the outer side of external dorsal keel while esb_1 is distal to esb_2.

Setation. A striking feature of this new species is the remarkable apically perforated macrosetae, figs 22–23 and 25–26. I know of only one other scorpion for which similar setae have been described, namely *Microtityus rickyi* Kjellesvig-Waering, 1966, a neotropical endemic species of Buthidae from the island of Trinidad. These were first described by San Martin (1968), who proposed that they function as sensory receptors. Foelix & Chu-Wang's paper (1973) on similar apically perforated setae in spiders strongly suggests that the macrosetae described by San Martin and myself in this paper function as contact chemoreceptors. The only other abherent type of setae described in scorpions are the very short and plumose setae found on the prosoma and tergites of *Microbuthus fagei* Vachon, 1949, a species of Buthidae from Mauritania.

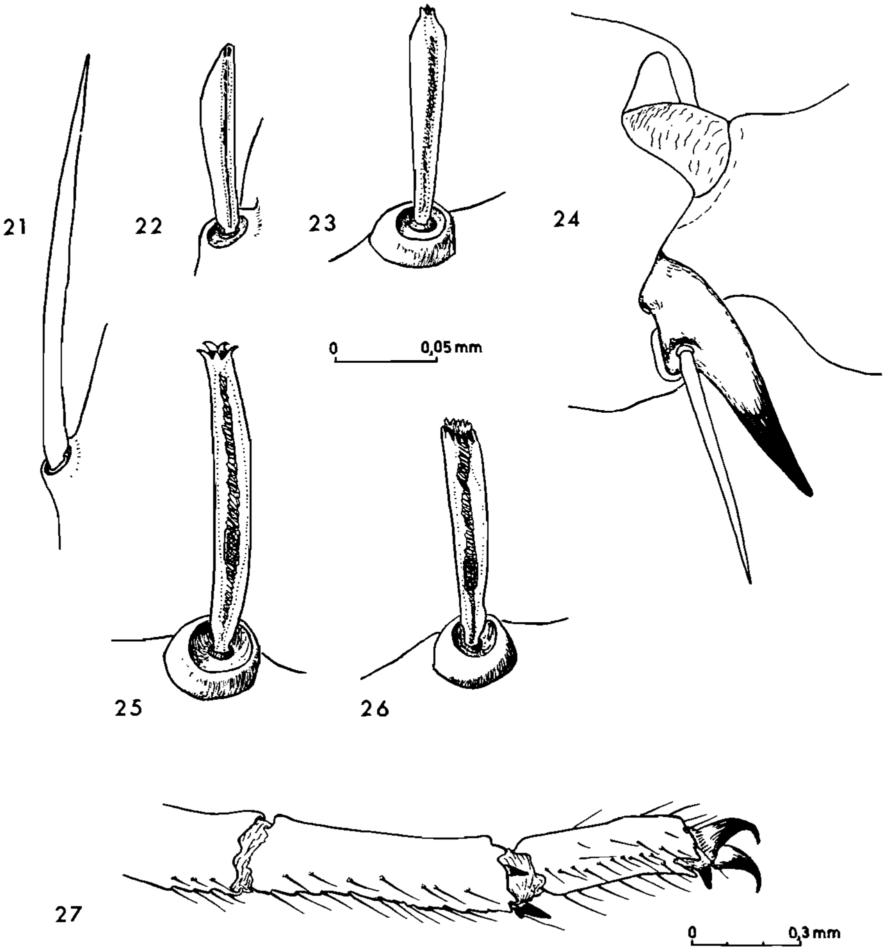
The size and shape of the specialized macrosetae of *Akentrobuthus leleupi* vary, as seen from figs 22–23 and 25–26, while their distribution and number are fairly regular. These macrosetae are found on: pedipalp hand, tibia femur and trochanter (M in figs 3–5 and 7); anterior margin of prosoma (M in fig. 8); coxa, trochanter, prefemur and femur of legs I–IV; inner marginal lamellae of pectines (fig. 19); posterior outer corner of sternites IV–VI; ventral and lateral surfaces of cauda I–V (M in fig. 14 for cauda V).

This new species is otherwise remarkably apilose. The parts that bear specialized sensory macrosetae, as listed above, are almost totally devoid of any setae. A few scattered setae are only found on the following: fixed and movable fingers of pedipalp hand; chelicerae; tibia, basitarsus and tarsus of legs I–IV; genital operculum and pectines; telson (fig. 13).

Measurements. Measurements of most individual body parts are indicated through the scales provided with each drawing. Other holotype measurements are as follows in mm: total body length, namely from anterior margin of prosoma to distal end of telson, 16 mm; length, width and height respectively of caudal segments, I 0,90 1,05 0,90, II 1,00 0,95 0,90, III 1,10 0,95 0,90, IV 1,30 0,90 0,90, V 2,10 0,85 0,80; width and length respectively of tergites, I 1,9 0,4, II 2,0 0,5, III 2,2 0,6, IV 2,3 0,7, V 2,3 0,8, VI 2,2 0,9; width and length respectively of sternites, III 1,6 0,9, IV 1,9 1,0, V 2,0 1,0, VI 1,9 1,1.

Type material repositories. The type series consists of a holotype and 17 paratypes deposited in the following institutions: Museé Royal de l'Afrique Centrale, Tervuren, Holotype ♀ (R. G. Mus. Congo 75735) and 13 paratype ♀ (see R. G. Mus. Congo and R. G. Mus. Afr. Cent. numbers under material examined below); Natal Museum, Pietermaritzburg, four paratype ♀ (NM 10706–10709).

Material examined. HOLOTYPE ♀: (humus) KIVU, Kalche, Bunyakiri, alt. 1 050 m, Sept. 1953, N. Leleup (R. G. Mus. Congo 75735). PARATYPES ♀: same data as holotype (R. G. Mus. Congo 75730, 75731–75733, 75599, 75664–75665, NM 10706 & 10708); dans humus, forêt primaire, Kivu, Territoire de Mwenga, Poste Kitutu, Bac de l'Elila, rive droite, alt. 650 m, April 1958, N. Leleup (R. G. Mus. Congo 111210 & 111304, NM 10709); dans humus, Territoire Masisi, Mutakato, alt. 800 m,



Figs 21–27. *Akentrobuthus leleupi* sp. nov. Holotype. 21. Normal elongate seta from dorsal surface of leg III basitarsus. 22–23 and 25–26. Apically perforated sensory macrosetae which possibly function as contact chemoreceptors; 22, from prefemur III, distal end of dorsal keel; 23, id. of ventral keel; 25 and 26 from femur III, ventral keel. 24. Outer tarsal spur of left leg III showing single basal seta. 27. Basitarsus and tarsus right leg IV, inner, ventro-lateral aspect. 21–26 same scale as indicated.

Sept. 1953, N. Leleup (R. G. Mus. Congo 81365, NM 10707); dans humus, forêt claire, Yangambi, 11 Oct. 1959, Dessart (INEAC) (R. G. Mus. Congo 115877); Kivu, Lwiro, 2 May 1972, A. B. Wabo (R. G. Mus. Afr. Centr. 141. 757).

Distribution. All the localities listed above are in the Kivu province of eastern Zaïre except for Yangambi (0° 47′ N, 24° 28′ E) west of Kisangani in the Orientale province.

Bionomics. Leleup (lit. comm., 1975) supplies the following information: 'Je ne possède malheureusement aucune photo des stations forestière où j'ai recueilli *Akentrobuthus*: en forêt tropicale dense, les photos du sousbois sont d'ailleurs décevantes et sans grande signification. En revanche, je puis vous confirmer que l'espèce est essentiellement humicole et peuple non seulement la grande forêt ombrophile de basse altitude, mais encore la forêt ombrophile de transition (Lwiro: altitude 1 700 m).

'J'ai le plus souvent recueilli ce Scorpion dans les endroits ou l'humus est épais, soit dans la litière supérieure encore constituée de détritus organisés et qui correspond à la couche L de l'horizon Ao des pédologues (cf. mon travail 1965: 71–73), soit dans la couche F (=couche de fermentation qui peut manquer dans les régions tropicales par suite de l'abondance des Termites). L'espèce a donc un mode de vie mésogée et non endogée. Comme vous le dites, la réduction des yeux et la disparition de la pubescence générale sont des caractères d'évolution régressive en corrélation avec la mode de vie humicole. La différenciation des soies sensorielles en organes chémorécepteurs est très certainement liée elle aussi à ce type de biotype; mais il s'agit ici d'une évolution progressive, compensatoire. La taille exigüe d'*Akentrobuthus* est également en conformité avec son mode de vie puisqu' elle lui permet de se faufiler dans les strates des sols forestiers.'

ACKNOWLEDGEMENTS

This new taxon was found while working on the arachnid collection in the Musée Royal de l'Afrique Centrale in Tervuren in 1974, and I have great pleasure in thanking Prof. P. L. G. Benoit for his hospitality and congenial assistance during and after my study period in his department at this institution. I am also indebted to Dr N. Leleup of the above institution for additional information on the bionomics of this new taxon, to Dr Brian Stuckenberg of the Natal Museum and Prof. Max Vachon for many useful comments, and to Dr Erik K. Waering for literature and comments.

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